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PENAEOPSIS EDUARDOI, A NEW SPECIES OF SHRIMP (CRUSTACEA: PENAEIDAE) FROM THE INDO-WEST PACIFIC

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During a revision of the genus *Penaeopsis*, I discovered that a very distinct Indo-West Pacific species had not been recognized previously, representatives having been repeatedly assigned to 2 other species, both named by Bate in 1881.

As indicated in the list of material examined, my conclusions are based on a study of the *Penaeopsis* collected during the voyage of the *Challenger*, 1873–76 and identified by Bate, including the types of his species, "*Penaeus rectacutus*" and "*P. serratus*." Also examined were 6 specimens described by de Man, and the relatively large collection of *Penaeopsis* taken by the U.S. steamer *Albatross* during the Philippine Expedition, 1907–1909, which includes representatives of 3 of the 4 species found in the Indo-West Pacific.

The method of measuring specimens and the terminology used below are described by Pérez Farfante (1969). The scales accompanying the illustrations are in millimeters. The materials used are in the collections of the British Museum (Natural History) (BMNH), National Museum of Natural History (USNM), and the Zoological Museum, Amsterdam (ZMA).

Penaeopsis eduardoi, new species
Figs. 1–4

Penaeus rectacutus.—Bate, 1888:266 [part], pl. 36, fig. 2z. —? Villaluz and Arriola, 1938:38, pl. 3 [not *Penaeus rectacutus* Bate, 1881].

Penaeus serratus.—Bate, 1888:268 [part], pl. 37, fig. 1″, 1q [not *Penaeus serratus* Bate, 1881].

Metapenaeus rectacutus.—Alcock and Anderson, 1894:145 [at least all males].

Parapenaeus rectacutus.—de Man, 1911:82.—de Man, 1913, pl. 8, fig. 26a–c. —Yokoya, 1933:9.

Penaeopsis rectactus.—Kubo, 1949:321, fig. 1H; 8J; 19C; 23A–B; 36K–L; 47J; 58P; 76A, F; 78K; 118A–G; 119.

Penaeopsis challengeri de Man, 1911: 76 [part, ♀ from *Siboga*-Expedition sta 253].—Ivanov and Hassan, 1976:4.

Review of Literature

The Indo-West Pacific members of the genus *Penaeopsis* often have been misidentified. Bate (1881) first gave brief diagnoses of 2 species under the names of *Penaeus rectacutus* and *Penaeus serratus*, and a few years later

(1888) presented rather extensive descriptions of both, which have been responsible for much subsequent confusion. This confusion has been due mainly to the following: a. The posterior part of the telson is missing in the specimen which Bate (1888) designated the type of *P. rectacutus* (p. 268), as he stated and clearly indicated in the illustration of the entire animal (Pl. 36, Fig. 2). b. Bate (1888) assigned to *P. serratus* a male—the petasma of which he described and figured (Pl. 37, Fig. 1″)—that actually belongs to a different species, *Penaeopsis eduardoi* n. sp. c. The original descriptions and the drawing of the thelycum of *P. serratus* lack necessary detail, and the illustration of the telson is inaccurate.

The material on which Bate (1881) based his diagnosis of *Penaeus rectacutus* was obtained in the Philippine Islands, the only locality cited by him. In 1888, however, he listed in addition to the type (mentioned on p. 268), 5 females caught off Matuku, Fiji Islands, at *Challenger* sta 173. He stated that "The telson in the typical specimen has two small articulating spines on each side, beyond which it has been broken off." Referring to the 5 females he wrote "the form of the thelycum in these corresponds with that of the type [of *P. rectacutus*], but differs from that of *Penaeus serratus*, with which they were found associated. In these specimens the telson is armed with two teeth posterior to the lateral spines, and therefore *Penaeus rectacutus* may be only a variety [presumably of *P. serratus*]." I have examined 3 of these 5 females, none of which belong to either species, but to the one described herein, as does the male Bate attributed to *P. serratus*. Furthermore, my examination of the telson of Bate's specimen of *P. serratus* which was illustrated (1888, Pl. 37, Fig. 1z) as lacking movable spines, revealed the presence of 3 such spines on each side, instead of 2 as stated (Bate, 1888).

The study of numerous specimens of *Penaeopsis rectacuta* obtained since 1888, leaves no doubt that, like "*Penaeus serratus*" (= *Penaeopsis challengeri* de Man, 1911), this species usually possesses 3 pairs of movable spines on the telson; only occasionally are there only 2 pairs, as was reported by Ramadan (1938). Thus, most specimens of *Penaeopsis rectacuta* differ from *Penaeopsis balssi* Ivanov and Hassan, 1976, and *Penaeopsis eduardoi*, n. sp., the other 2 Indo-West Pacific species which exhibit only 2 pairs of movable spines. Also, the thelycum of *P. rectacuta*, although superficially resembling the thelyca of the other Indo-West Pacific *Penaeopsis*, exhibits various features (clearly indicated in the illustration presented by Bate, 1888, Pl. 36, Fig. 2″) by which the females may be recognized readily. Furthermore, the males of this species, which were not available to Bate, differ markedly from those of *P. eduardoi*.

Following Bate's erroneous assignation of the male in which the ventral costa of the petasma is produced distally into a long spinelike projection to "*Penaeus serratus*," a few authors relegated to this species not only the males,

but also the females of *P. eduardoi.* Others, apparently recognizing that the thelycum of the females accompanying the males of *P. eduardoi* was different from that of the females of "*P. serratus*," resembling more closely that of *P. rectacuta*, assigned their specimens to the latter. This misidentification was made by de Man (1911; 1913) and Kubo (1949), both thus unknowingly having noted in their descriptive accounts, and represented in illustrations, features by which *P. eduardoi* may be distinguished from *P. rectacuta.*

Diagnosis.—First rostral tooth situated opposite orbital margin. Telson bearing 2 pairs of movable spines, its terminal part hastate. Petasma with ventral costa produced into long distal spine projecting beyond row of cincinnuli. Thelycum with plate on sternite XIV bearing caudally pedunculate posteromedian protuberance; posteromedian projection of plate on sternite XIII conspicuously bifid caudally, and tooth on sternite XII broad basally, semiconical, elongate and directed anteriorly.

Description.—Rostrum (Fig. 1) horizontal to somewhat upturned, straight or slightly sinuous (strongly convex in young); length proportionately increasing with size of shrimp, in adult relatively long, reaching at least midlength of third antennular article and often overreaching peduncle (in large females), its maximum length about 0.8 that of carapace. Rostral plus epigastric teeth 8–15 (increasing in number through juvenile stage), basal rostral teeth close together, ultimate 3 or 4 usually relatively widely spaced; first rostral tooth situated at level of orbital margin; epigastric tooth situated about 0.35 carapace length from orbital margin. Paired adrostral carinae low, sharp posteriorly, almost indistinct along anteriormost portion of rostrum, dorsal one running along bases of teeth. Postrostral carina high anteriorly, lower, although well defined, behind epigastric tooth ending at about posterior 0.4 length of carapace, and followed by small dorsal tubercle located near posterior margin of carapace. Antennal and hepatic spines well developed, subequal in size; pterygostomian spine conspicuous, anteroventral angle of carapace broadly obtuse (Fig. 2*a*). Cervical carina elevated and sharp, accompanying sulcus well marked; its posterodorsal extremity located about 0.45 length of carapace from orbital margin, and relatively far from postrostral carina. Hepatic carina anteriorly high, sharp, sinuous, extending from below hepatic spine to apex of pterygostomian spine; hepatic sulcus well marked along carina, very shallow posteriorly. Branchiocardiac carina extending posterodorsally to near margin of carapace, indistinct in many large individuals.

Antennular peduncle with length about 0.65 that of carapace, third article narrow and about 1.2 times as long as second; prosartema falling short of distal margin of first article; stylocerite ending in small spine, length about 0.4 that of first article; distolateral spine long, slender and sharp, reaching between basal 0.65 and distal margin of second article; parapenaeid spine

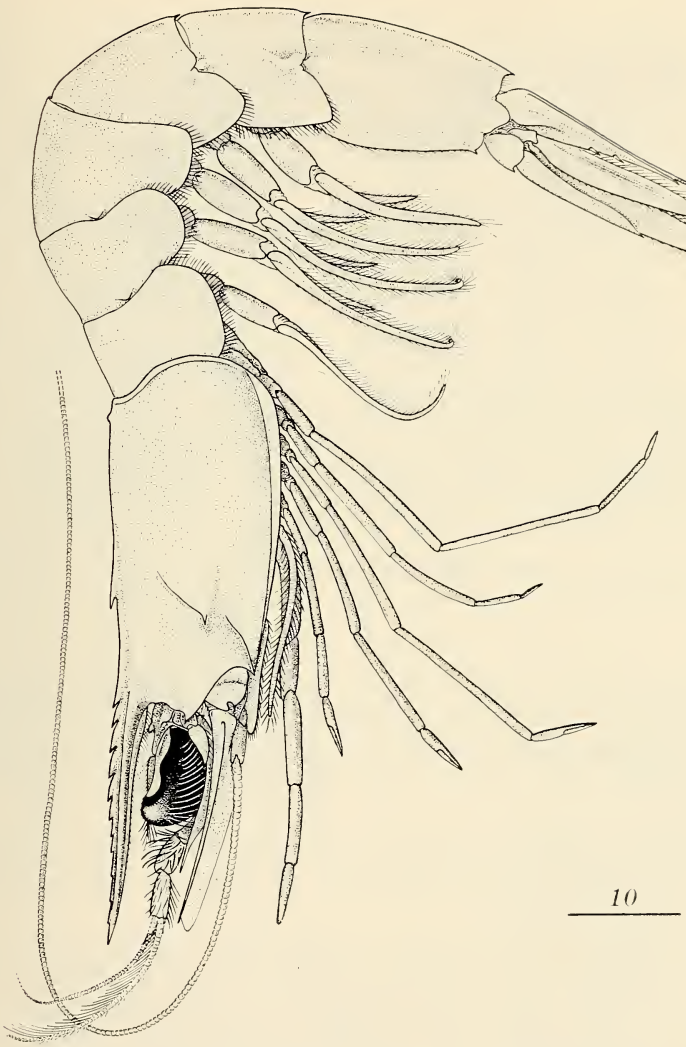

Fig. 1. *Penaeopsis eduardoi*, holotype ♀, 27 mm cl, Balayan Bay, Luzon I, The Philippines: Lateral view.

very long, considerably overreaching distal margin of article. Lateral flagellum as long as, or longer than carapace, not tapering, broad proximally, filiform distally; ventral flagellum sexually dimorphic: in female straight, tapering to filiform terminal part, its length about 0.8 that of carapace; in male deeply concave basally forming semicircle, latter joining straight distal part by dorsally arched thickening.

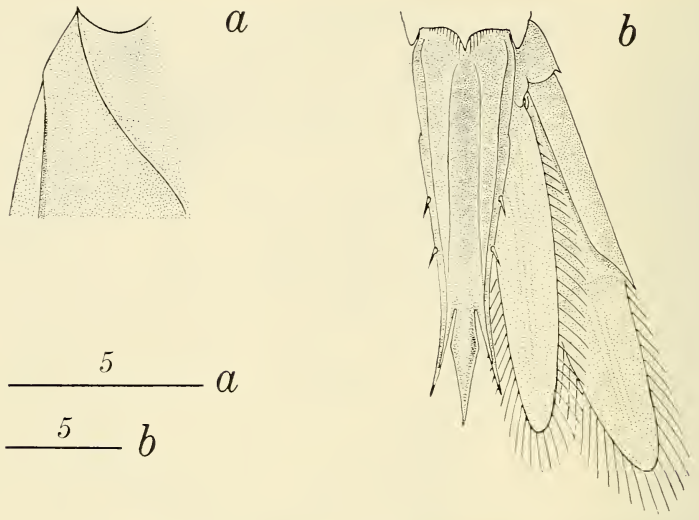

Fig. 2. *Penaeopsis eduardoi*, holotype: *a*, Enlargement of anteroventral part of carapace; *b*, Telson and right uropod.

Scaphocerite extending to, or barely surpassing, antennular peduncle; lateral rib ending in sharp spine falling slightly short of distal margin of lamella. Antennal flagellum broken in specimens examined, but not less than twice body length: in female 136 mm total length, incomplete flagellum 268 mm long.

Third maxilliped of male extending as far as distal 0.35 of third antennular article, that of female to distal margin; ratio of dactyl: propodus about 0.70 in male, and 0.75 in female.

First pereopod reaching about distal end of carpocerite, armed with spines on basis and ischium. Second pereopod overreaching carpocerite by length of dactyl or by almost entire propodus (also reaching at least distal 0.4, at most 0.1, of first antennular article), with basis and ischium unarmed. Third pereopod of male reaching between proximal 0.35 and distal end of second article, that of female, between midlength and distal end of third article. Fourth pereopod extending to distal end of carpocerite or surpassing it by length of dactyl, thus about as far as first. Fifth pereopod reaching between base and midlength of second article. Order of above appendages in terms of their maximum anterior extensions: first, fourth, second, third and fifth pereopod, and third maxilliped.

Abdomen with dorsal keel on fourth to sixth somites, posterodorsal margin of fourth and fifth with median incision; length of sixth somite about 1.7 times maximum height, bearing long, usually interrupted cicatrix on

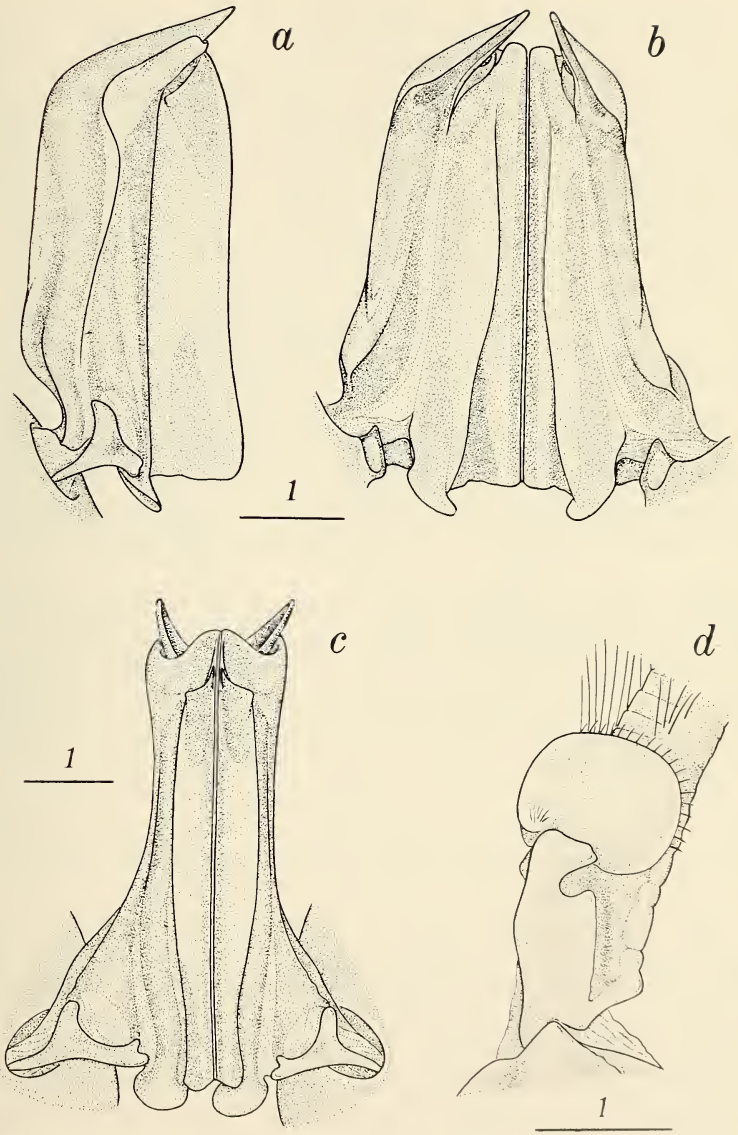

Fig. 3. *Penaeopsis eduardoi*, ♂, 16.5 mm cl, off Matuku, Fiji Islands: *a*, Lateral view of left half of petasma. *b*, Ventral view of petasma slightly extended; *c*, Dorsal view of same petasma; *d*, Dorsal view of right appendix masculina. (Illustrations prepared from stained specimens.)

lateral surface, conspicuous spine at posterior end of keel, and pair of minute spines posteroventrally. Telson (Fig. 2b) with median sulcus flanked anteriorly by 2 pairs of slender ridges, lateral pair extending to fixed spines; latter very long, in young extending as far as apex of telson; lateral margins of telson armed with 2 pairs of small, slender, movable spines, anterior pair situated about 0.4 length of telson from anterior margin, posterior pair slightly closer to other movable spines than to fixed ones; terminal part hastate, its length 6 to 7 times basal width. Mesial ramus of uropod reaching, or slightly overreaching, apex of telson; lateral ramus surpassing mesial one by almost 0.2 of its own length.

Petasma (Fig. 3a–c) with ventral costa marginally situated distomesially (where bent inward) and continuing along curved distomesial margin at angle of about 40° to shaft of petasma; distal part of costa free from, though closely appressed to, margin of dorsolateral lobule, forming long spine projecting anterodorsally (sometimes also toward median line) beyond row of cincinnuli (hooklike structures along mesial margin of median lobes of petasma that serve to interlock its 2 halves). Ventromedian lobule with proximal plate flush with surrounding membranous portion, lacking mesial crest.

Appendix masculina (Fig. 3d) transversely oval, broader than long, strongly convex dorsally, and bearing short setae around entire margin.

Thelycum (Fig. 4) with paired anterior borders of plate of sternite XIV strongly arched, sloping posterolaterally, and separated by emargination receiving posteromedian projection of sternite XIII; lateral borders constricted (sharply turning mesially behind midlength) before joining posterior ridge; plate conspicuously overlapping sternite XIII, densely setose anteriorly, strongly slanting dorsomesially toward deep anteromedian part, and armed with short, caudally pedunculate posteromedian protuberance. Median plate of sternite XIII semicircular to subcordiform (with blunt apex), flat, studded with setae, its posteromedian projection caudally bifurcate. Sternite XII with posteromedian, subconical, broad (rather than compressed) tooth, and pair of strong ribs across posterolateral borders.

Maximum carapace length, males 26 mm; females 34 mm.

Material examined.—Holotype: ♀, USNM 168298, 27 mm carapace length; about 120 mm total length; 22 mm rostrum length; epigastric plus 11 rostral teeth. Type-locality: Balayan Bay, Luzon I, The Philippines, 13°41′00″N, 120°47′05″E, 366 m, *Albatross* sta 5116.

Paratypes.—9♂ 7♀, USNM 168299, collected with the holotype.

Other specimens.—Fiji Islands. 1♂ 3♀, BMNH, off Matuku, 576 m, 24 July 1874, *Challenger* sta 173. *South China Sea.* 1♀, USNM, SW of Taiwan, 421 m, 5 November 1908, *Albatross* sta 5317. *The Philippines.* Luzon: 1♂, USNM, off Hermana Menor I, 326 m, 22 November 1908, *Albatross* sta 5331; 1♀, USNM, Balayan Bay, 324 m, 17 January 1908, *Albatross* sta 5112;

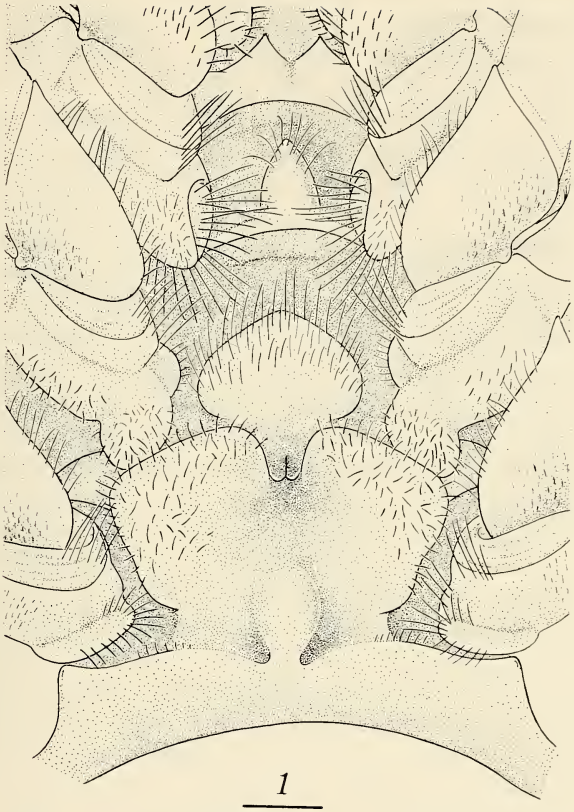

Fig. 4. *Penaeopsis eduardoi*, holotype: Thelycum.

1♂, USNM, Albay Gulf, 368 m, 8 June 1909, *Albatross* sta 5459. Bohol Strait (between Cebu and Bohol): 1♀, USNM, 296 m, 23 March 1909, *Albatross* sta 5412; 3♂ 1♀, USNM, 402 m, 9 April 1908, *Albatross* sta 5198. Mindanao: 3♂ 1♀, USNM, off Tagolo Point, 401 m, 20 August 1909, *Albatross* sta 5541; 1♂ 6♀, USNM, off Tagolo Point, 366 m, 9 August 1909, *Albatross* sta 5518; 1♀, USNM, Macalajar Bay, 366–402 m, 5 August 1909, *Albatross* sta 5504–5; 1♂ 1♀, USNM, off El Salvador, 391–413 m, 4 August 1909, *Albatross* sta 5502–3; 1♂, USNM, Iligan Bay, 494 m, 5 August 1909, *Albatross* sta. 5508. *Indonesia.* 3♀, ZMA, Makassar Strait, 450 m, 8 June 1899, *Siboga* sta 74. 1♀, ZMA, off Kai I, 304 m, 10 December 1899, *Siboga* sta 253. 1♂, ZMA, Bali Sea, 289 m, 14 March 1899, *Siboga* sta 12. 1♀, ZMA, off Paternoster Is, 521 m, 1 April 1899, *Siboga* sta 38.

Comparative specimens of other species: Holotype ♀ *Penaeus rectacutus*

Bate, 1881, BMNH, between Bohol and Cebu, The Philippines, 95 fm (174 m), 22 January 1875, *Challenger* sta 209. Syntypes 4♀ *Penaeus serratus* Bate, 1881, BMNH, off Matuku, Fiji Islands, 315 fm (576 m), 24 July 1874, *Challenger* sta 173.

Geographic and bathymetric ranges.—This species has been found off the Fiji Islands and from Japan through The Philippines and Indonesia to the southwestern part of the Bay of Bengal, in depths between 290 and 570 m.

Etymology.—This species is named for my son, Eduardo Canet.

Discussion.—As stated above, *Penaeopsis eduardoi* differs from both *P. rectacuta* and *P. challengeri* de Man, 1911 [replacement name for *Penaeopsis serrata* (Bate, 1881)], in possessing 2 pairs of movable spines on the telson, a character it shares with *P. balssi*, as well as with the amphi-Atlantic *P. serrata* Bate, 1881, which only rarely bears 3 pairs (Burkenroad, 1934). *Penaeopsis eduardoi*, however, can be separated from all its 4 congeners by the external genitalia. It is the only species in which the ventral costa of the petasma is produced into a long distal spine projecting beyond the row of cincinnuli. The thelycum, in turn, is unique in that the plate on sternite XIV exhibits a caudally pedunculate posteromedian protuberance, whereas in all the other species the latter is represented by a ridge or protuberance which is broad caudally or lacks a peduncle. Also the posteromedian projection of the plate on sternite XIII is conspicuously bifid caudally whereas in the other species it is straight or broadly emarginate, except in occasional females of *P. rectacuta* in which a shallow incision is present. Furthermore, sternite XII is armed with an elongate, broad basally, semiconical, anteriorly directed tooth, which in the other members of *Penaeopsis* is absent or, if present, either laterally compressed, or short, conical and directed ventrally.

Because the thelycum of *P. eduardoi* has been considered identical with, or very close to that of *P. rectacuta*, the differences between the two are given. In *P. eduardoi* the anterior borders of the plate of sternite XIV are directed posterolaterally and the lateral ones constricted, whereas in *P. rectacuta* the anterior borders are subhorizontal, the lateral ones virtually straight. Also in the latter species the protuberance born on the plate of XIV is caudally broad (often continued anteriorly as a ridge), the median plate of sternite XIII is cordiform (sharply pointed anteriorly) and concave, and the tooth on sternite XII is strongly compressed. In addition to the differences in the external genitalia as well as in the number of telsonic spines pointed out above, *P. eduardoi* may be distinguished from *P. rectacuta* by the position of the first rostral tooth, situated opposite the orbital margin in the former whereas conspicuously posterior to it in the latter.

My examination of the specimens collected during the *Siboga* Expedition and studied by de Man (1911), demonstrated that the juvenile female

from sta 253, which he identified as *Penaeopsis challengeri* belongs to *P. eduardoi*, as do the male from sta 12, the female from sta 38, and the 3 females from sta 74 which he named *Parapenaeus rectacutus*. Contrary to de Man's statement, the juvenile does possess exopods on all pereopods; however, they are minute and thus easily overlooked.

The descriptions and illustrations presented by Kubo (1949) leave no doubt that the Japanese shrimps he recognized as *Penaeopsis rectactus* (incorrect subsequent spelling of *rectacutus* which, according to Article 33b of the International Code of Zoological Nomenclature, cannot be used as a replacement name) are *P. eduardoi*. Kubo's observations indicate that his specimens exhibit slight differences from those recorded by other authors, e.g., the sixth abdominal somite lacks a cicatrix whereas in those from other waters it possesses an interrupted one, and the length of the third antennular article is 1.5 times that of the second whereas in the material examined by me it is only about 1.2 times. Regarding his conclusion that the Japanese specimens differ from Indonesian specimens in possessing a postrostral carina, I wish to point out that it is based on an omission in the otherwise fine descriptive account given by de Man; such a carina is present in the specimens de Man saw.

I have found the following slight intraspecific variation in thelycal features of *P. eduardoi*: The plate of sternite XIV may have the anterior and lateral borders joined forming an almost perfect arc or an obtuse angle, and the median plate of sternite XIII may vary from nearly semicircular to subcordiform. I have observed too that the third maxilliped, the third and, sometimes, fifth pereopods reach about the same level, but the fifth pereopod may not extend nearly so far anteriorly. Also, as previously indicated by Kubo (1949), the third maxilliped and the third pereopod are slightly longer in females than in males, and the ratio of dactyl:propodus of the third maxilliped is larger in the former than in the latter. These differences, however, are virtually insignificant.

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